

REMARKS

Claims 1, 7, 10 and 28 have been amended; claims 6 and 15 have been canceled; and claims 2-5, 8-9, 11-14, 16-27 and 29-41 remain unchanged. Thus, claims 1-5, 7-14 and 16-41 are pending.

Claims 1, 2, 3, 4, 5 and 25 stand rejected under 35 U.S.C. 102(e) as being anticipated by Bhan et al. (USP 6,090,167).

Claims 6, 7, 8 and 9 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Bhan et al. and further in view of Applicants prior art.

Claims 10-24 and 29-33 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Applicants prior art in view of Bhan et al.

Claims 34, 35, 36, 37, 38, 39, 40 and 41 stand rejected under 35 U.S.C. 103(a) as being unpatentable over Applicants prior art in view of Bhan et al. and further in view of Nag et al. (USP 6,268,297 B1).

As amended, all the pending claims of the subject application comply with all requirements of 35 U.S.C. Accordingly, Applicant requests examination and allowance of all pending claims.

The Rejections Under 35 U.S.C. 102(e)

Claims 1, 2, 3, 4, 5 and 25 stand rejected under 35 U.S.C. 102(e) as being anticipated by Bhan et al. (USP 6,090,167). Each of claims 2-5 and 25 depends on claim 1. Claim 1 has been amended to include the limitation previously recited in dependent claim 6 that the deposited silicon oxide layer has a fluorine content of less than 1.0 atomic percent. As acknowledged in the Office Action (see page 4, paragraph 10), Bhan et al. does not teach this limitation. Accordingly, Applicants request the withdraw of the Section 102 rejection of claims 1-5 and 25. Applicants further assert that amended claim 1 is patentable over the art of record as discussed below with respect to the Section 103 rejection.

The Rejections Under 35 U.S.C. 103(a)

1. Claim 1 and its dependents

As set forth above, claim 1 has been amended to include the limitation recited in claim 6. Claim 6, which has now been canceled, was previously rejected under 35 U.S.C. 103(a) as being unpatentable over Bhan et al. in view of Applicants admitted prior art. This rejection is traversed as set forth below.

As an initial matter, Applicants note that the Bhan et al. reference is one of many known patents related to improving the stability of fluorine-doped silica glass (FSG) films. As explained in Bhan et al., the inclusion of fluorine into a silicon oxide film (an FSG film) has an important benefit of lowering the dielectric constant of the film. Col. 1, line 66 to col. 2, line 23. A person of skill in the art would readily appreciate that the dielectric constant of an FSG layer is proportional to the amount of fluorine included in the film. The skilled artisan would also realize, however, that when too much fluorine is incorporated into an FSG layer, film stability becomes a problem.

The Bhan et al. patent is specifically directed towards a technique that allows the formation of stable FSG layers having increasingly high levels of fluorine (and thus increasingly low dielectric constants). See e.g., col. 2, lines 35-67 and col. 5, lines 1-9. Thus, as the Examiner has realized, Bhan does not teach or suggest the formation of a silicon oxide layer having less than 1.0 atomic percent fluorine as recited in claim 1. Instead, Bhan et al. teaches away from the formation of such a layer. Furthermore, combining Bhan with another reference that teaches to incorporate little or no fluorine in a silicon oxide film defeats the intended purpose of Bhan et al. For these reasons alone, Applicants submit that the Section 103 rejection of claim 6 (now claim 1) is improper and request that it be withdrawn.

Moreover, while acknowledging that Bhan fails to disclose forming a silicon oxide layer from a process gas comprising silicon, oxygen and fluorine sources having a fluorine content of less than 1.0 atomic percent, the Rejection states "in view of Applicants admitted prior art, it would be obvious to one of ordinary skill in the art to have a fluorine content of less than 1.0 at. % because fluorine is more likely to outgas and migrate into an adjacent layer." See Page 4, paragraph #10.

Applicants submit that such logic is fatally flawed. The "admitted prior art" that the Rejection is referring to is a paragraph on page 3 of Applicants application that explains why FSG films are not typically used by semiconductor manufacturers for premetal dielectric (PMD) or shallow trench isolation (STI) applications. Specifically, this paragraph of Applicants specification states:

"Because of stability and other issues, FSG films are generally not used for PMD or STI applications and have been primarily limited to intermetal dielectric (IMD) applications. Semiconductor manufacturers are often particularly hesitant to include fluorine in PMD and STI layers because such layers are likely to be subject to relatively high temperatures (e.g., above 500°C and often above 700°C) either during deposition of the layer or during a process step that is subsequent to

deposition of the layer. At such high temperatures, fluorine is more likely to outgas from FSG layers and migrate into an adjacent layer. Thus, many semiconductor manufacturers require that PMD or STI layers have less than 1.0 atomic percent (at. %) fluorine. IMD layers, on the other hand, are typically deposited after the first metal layer and thus never subject temperatures above 450°C." (emphasis added)

As evident from the above paragraph, Applicants admitted prior art is explaining why semiconductor manufacturers generally exclude using fluorine in PMD and STI applications. A person of skill in the art would readily appreciate that the best way to exclude fluorine from a deposited layer is by using only deposition precursors (e.g., source gases) that do not include fluorine. Thus, a skilled artisan reading the above paragraph would not include a fluorine-containing source in the deposition gas as is required in claim 1 ("said process gas comprising a silicon-containing source, an oxygen-containing source and a fluorine-containing source"). For this additional reason, Applicants submit that the Section 103 rejection of claim 6 (now claim 1) is improper and request that it be withdrawn.

2. Independent Claims 10, 17 and 28

Independent claims 10 and 28 have each been amended to recite that the deposited silicon oxide layer includes less than 1.0 atomic percent fluorine. Independent claim 17 already included such a limitation. Thus, Applicants respectfully assert that each of these claims is patentable over the art of record for reasons similar to those set forth above with respect to claim 1.

CONCLUSION

In view of the foregoing, Applicants believe all claims now pending in this Application are in condition for allowance. The issuance of a formal Notice of Allowance at an early date is respectfully requested.

If the Examiner believes a telephone conference would expedite prosecution of this application, please telephone the undersigned at 650-326-2400.

Respectfully submitted,



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